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Iranian Soil Science Congress: History (1972–2017) and selected highlights

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ABSTRACT

This study describes the history and outcomes of the Iranian Soil Science Congress (ISSC). From 1972, the Soil Science Society of Iran (SSSI) has organized 15 ISSCs. The ISSC has been organized at six disciplines including (I) soil chemistry, (II) soil physics, (III) soil genesis and classification, (IV) soil biology, (V) soil erosion and conservation, (VI) soil fertility and plant nutrition, this structure still has remained. In the past 25 years, 7864 papers have been presented at ISSC and the soil fertility and plant nutrition discipline has the highest number of papers. The number of papers published in the ISSC has sextupled in the 10 years from 2001 to 2011, followed by a sharp decline (i.e., 43%) in 2015. Despite the large number of papers presented in the ISSCs, knowledge about how soils should be governed is little. It is expected that studies on climate change will have a special place among Iranian soil scientists in the future. To increase trends in environmental challenges and policy issues, interdisciplinary approaches are required. Therefore, Iranian soil scientists require national and international collaboration and communication with scientists in other disciplines to successfully manage the soils. Unfortunately, there are several pessimism and concerns on the future of soil science in Iran. To get out of this situation, modeling from the successful countries in this field seems necessary.

1. Introduction

Soil is essential for life and identified as being central to many of the challenges facing society, including food, water, energy security and supporting biodiversity, all of which contribute to human health (Bouma, 2014; McBratney et al., 2014; Arrouays et al., 2017). The soil is a critical component in understanding global issues and these require research that leads to understanding and solutions at national and regional levels (Hartemink, 2014).

Soil science is special and maturing science that became a scientific discipline in the 19th century when agricultural chemists and agro-geologists combined their efforts and soils were seen as natural bodies that ought to be studied independently (Hartemink et al., 2014). The content of soil science is uneasily placed between natural science on the one hand, and the world of professional practice on the other (Philip, 1991). In the first half of the 20th century, soil science grew rapidly and established some sub-disciplines such as pedology, soil chemistry, soil biology, soil fertility and soil physics (Brevik and Hartemink, 2010). Although, the soil science developments have been different in various parts of the world, one of the main pillars in the development of the soil science discipline has been the formation of an international learned society. The International Society of Soil Science (ISSS) or its successor the International Union of Soil Sciences (IUSS) has played a major role in the development and promotion of soil science as a discipline. Since the ISSS had paid little attention to historical developments, a working group was formed to deal with the history and sociology of soil science at the 12th congress of ISSS, held in New Delhi in 1982 (Boulaine, 1989). The IUSS provides opportunities to: (i) ensure the advancement of soil science and its application, (ii) to handle the business of the society, (iii) working groups through the World Congress of Soil Science (WCSS).

The Soil Science Society of Iran (SSSI) as a member of IUSS was formed 45 years ago with the aim of exchanging the latest research results and international sharing the advanced research methods in soil and environmental issues. The SSSI started with 5 members and presently has nearly 1223 members. Number of SSSI members increased dramatically (i.e., 5 versus 1223) over time from 1992 to 2017. From 1992 to 2000, the number of members grew steadily but between 2000 and 2017 the growth occurred with a higher rate (Fig. 1). This paper aims to investigate the history and outcomes of the ISSC from 1972 to 2017.

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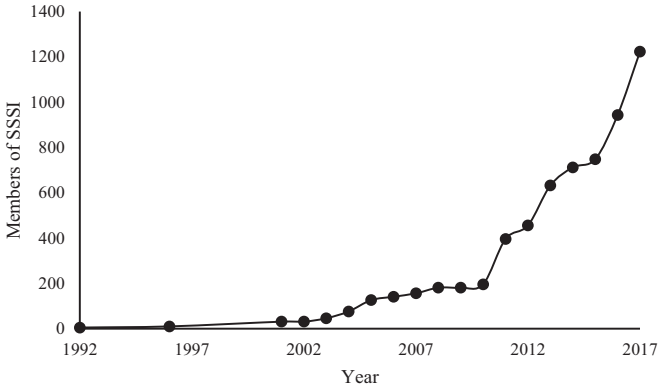

Fig. 1. Total members of the SSSI over time from 1992 to 2017.

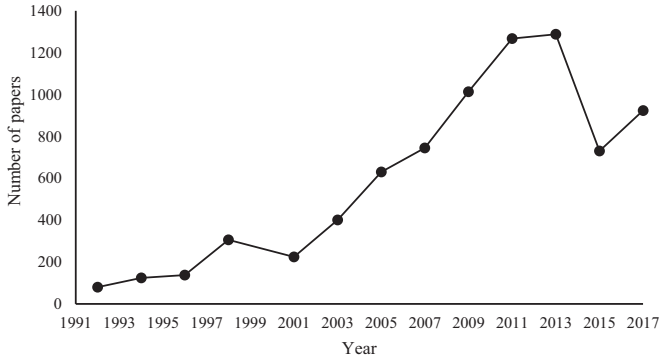

Fig. 2. Number of papers published in Iranian soil congresses over time from 1992 to 2017.

2. Methods

The archive of 15 ISSCs was collected and analyzed. In total, this work covers almost 7860 papers. All published papers in ISSCs were considered and different issues were extracted from this archive including (i) general information such as overview of ISSCs, number of papers published during ISSCs for various sub-disciplines; (ii) contribution of each province in compilation of papers; (iii) contribution of universities and research institutes in compilation papers during different decades and (iv) important issues discussed in ISSCs. Moreover, we prepared a questionnaire to collect the opinion of different Iranian soil scientists about the future of soil science in Iran.

3. Results and discussion

3.1. The ISSC history

Over the past 45 years, 15 ISSCs were held at different universities and research institutes of Iran under the guidance of the SSSI (Table 1). The Tehran University which is the oldest and the most prestigious Iranian university was selected as the first meeting place of the ISSC. The ISSC's activity interrupted from the mid-1970s to early 1990s because of Iran–Iraq war, Iranian cultural revolution and closure of the universities. After that, the ISSCs were held every two years (Table 1). From 1992 to 2017, 7864 papers have been presented at ISSC. Despite the author's many efforts, due to the lack of documentation or absence of appropriate archives, no information about the 1st and 2nd ISSC was received.

As Table 1 shows, every congress is based on a theme that covered various soil issues and organizer's efforts to focus the researcher's mind on these concepts and to discuss them. Unfortunately, these aims could not entirely shift the studies toward congress themes. The need for change in ISSC's theme had been recognized from 2007. Table 1 shows that from the 10th ISSC, the congress theme was adapted to harmonize with many of the problems (e.g., food security, water security, ecosystem sustainability and climate change) facing the world today.

3.2. Number of papers published in ISSCs

From 1992 to 1995 the number of papers grew steadily, reaching a high at the time of 1288 papers in 2013. The number of papers published in ISSCs has sextupled in the 10 years (from 2001 to 2011). However, in 2015 the number of papers dropped to 730, a decline of 43% (Fig. 2). Reasons for this decline may be include the multiplicity of congress in Iran and sometimes their concurrence with soil congress, relatively high costs and lack of financial accountability for some students, some headers preferred the quality of papers versus quantity, higher score of journal papers than congress papers for scientific promotion of faculty members in the universities and research institutes of Iran, decline in the quality of congress papers, lack of a suitable future in Iran for graduated students of soil science which consequently declines in their motivation to participate in the soil congresses. After that, the number of papers which presented at 15th ISSC increased 26% (Fig. 2).

Table 1
An overview of the ISSCs from 1972 to 2017.

ISSC	Year	Location	Header	Congress Theme
1st	1972	University of Tehran	NA[a]	NA[a]
2nd	1975	Shiraz University	NA[a]	NA[a]
3rd	1992	University of Tehran	Dr. Negarestan	Identification of soil resources and programming for optimal consumption
4th	1994	Isfahan University of Technology	Dr. Jalalian	Increase production yield per unit area
5th	1996	College of Agriculture of Karaj	Dr. Rozitalab	Optimal productivity of water and soil with emphasis on soil erosion
6th	1998	Ferdowsi University of Mashhad	Dr. Haghnia	More attention to soil genesis and classification
7th	2001	Shahrekord University	Dr. Givi	Sustainable development
8th	2003	University of Guilan	Dr. Haghparast Tanha	Achieve sustainable development
9th	2005	Soil Conservation and Watershed Management Research Center	Dr. Shoaei	Conservation of soil resource and optimal productivity of water and soil with emphasis on soil erosion
10th	2007	Agriculture and Natural Resources, University of Tehran	Dr. Sherfa	Sustainable soil management
11th	2009	Gorgan University of Agricultural Sciences and Natural Resources	Dr. Khormali	Soil management and food security
12th	2011	University of Tabriz	Dr. Jafarzadeh	Soil degradation and land suitability management
13th	2013	Shahid Chamran University of Ahvaz	Dr. Landi	Sustainable soil, sustainable production
14th	2015	Vali-e-Asr University of Rafsanjan	Dr. Mozafari	Soil security-clean life
15th	2017	Isfahan University of Technology	Dr. Hajabbasi	Soil-health-life

[a] Not available.

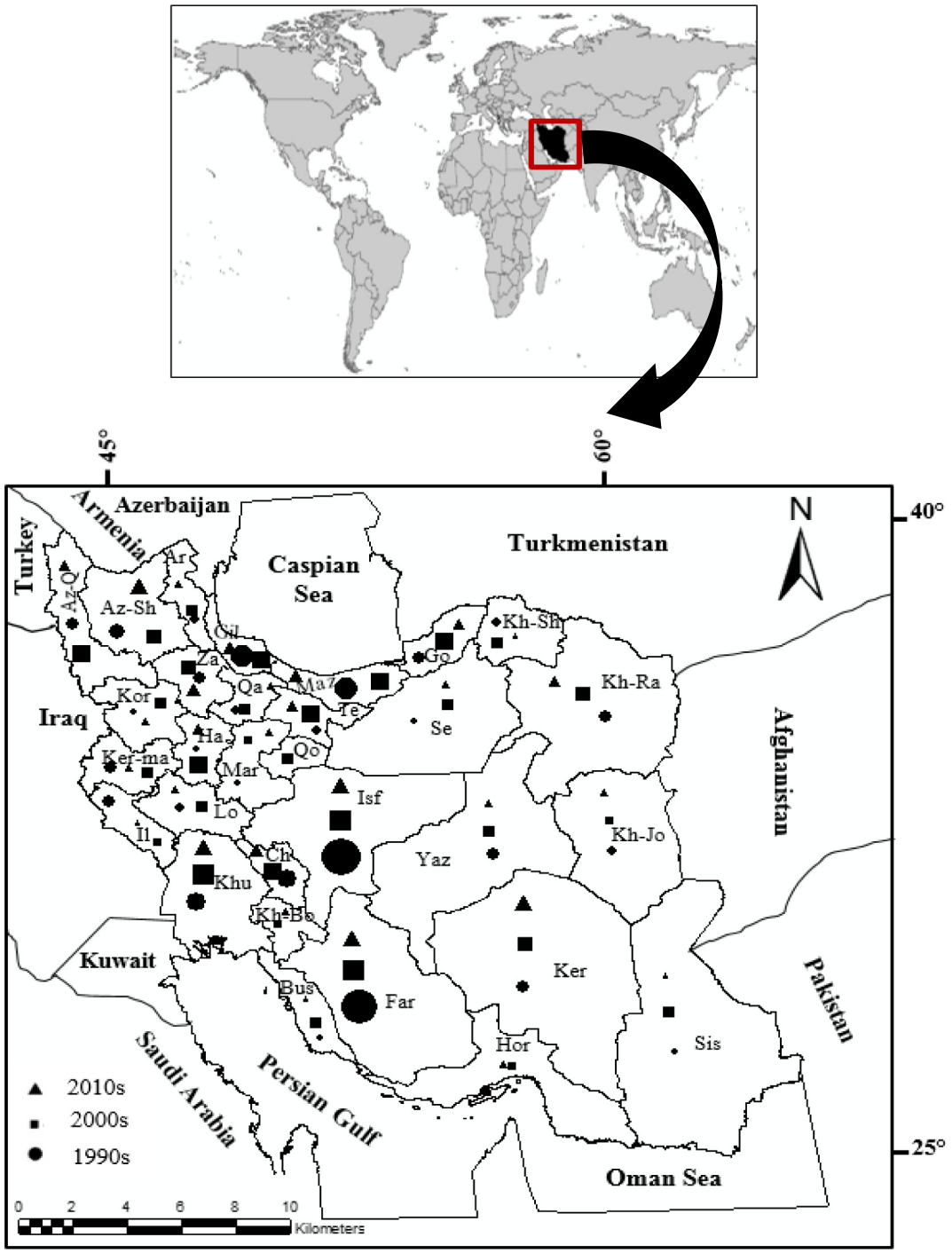

Fig. 3. Number of soil science studies at various decades for different provinces of Iran (size of symbols indicates the number of studies).

The number of papers in various decades for different provinces of Iran is shown in Fig. 3. Results showed that in the 1990s one quarter of the papers came from the Isfahan Province, 18% papers from Fars Province and 7% from Mazandaran Province. In the 2000s, Isfahan, Fars and Khuzestan Provinces with 10%, 9% and 7% of papers ranked first to third. Also, results declared in the 2010s, Isfahan (10%), Khuzestan (9%) and Fars (8%) Provinces had the most papers. In other provinces, the number of papers was different from one decade to another decade. Probably the unequal distribution of laboratory facilities and experts caused that in provinces such as Sistan and Baluchestan, Hormozgan and Bushehr the number of soil studies is very little (Fig. 3).

Although the Khuzestan Province has a good place in terms of soil studies, problems such as soil salinity, aerosols and high rate of soil erosion in this province show that these studies have led to neither proper management nor soil governance. Soil management is understood as integral part of land management that may focus on (i) availability of land for soil use (soil quantity), and (ii) differences in soil types and soil characteristics (soil quality) to define specific interventions that are aimed to sustain soils and to enhance the soil quality for the land use selected (FAO Soils Portal). Soil governance concerns policies and strategies of decision making by nation states and local governments on how the soil is utilized. Juerges and Hansjürgens (2018) declared that although there is broad agreement about the importance of soils and the necessity to manage them sustainably, little is

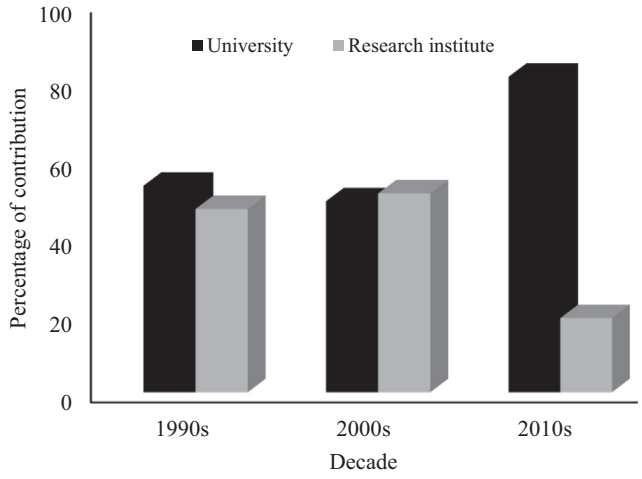

Fig. 4. The contribution of universities and research institutes in the ISSCs during different decades.

known about how soils should be governed to maintain them and to ensure their long-term vitality and sustainable use.

The contribution of universities and research institutes in the ISSC's papers compilation during different decades is shown in Fig. 4. In the 1990s and 2000s universities and research institutes have more or less a similar contribution but the number of papers compiled by universities has quadruplicated in the 2010s. The investigations showed that the 70% of the M.Sc. degree students were involved in the papers compilation in the 2010s (unpublished data). In recent decades, the policy of higher education has changed in Iran probably in order to achieve new technologies for social progress and financial development. Although the role of enhancing volunteers for academic education at a time frame cannot be denied. Therefore, there was a considerable increase in the number of soil science students in the past decades. Hamdhaidari et al. (2008) explained that the development of higher education during last 26-year period can be divided into revolutionary, formative and development phases. Trends in the soil science student numbers at Bachelor of Science (BSc), Master of Science (MSc) and Philosophiae Doctor (PhD) degrees during different decades are shown in Fig. 5. According to information of Institute for Research and Planning in Higher Education (http://irphe.ac.ir), the number of soil science students at BSc degree was 889 in the 1990s that increased to 6061 in 2010s. From 1990s to 2010s, the number of soil science students increased 20 times and 46 times at MSc and PhD degree, respectively (Fig. 5). These results confirmed that the soil science student numbers dramatically increased at all degrees in recent years. In the period of

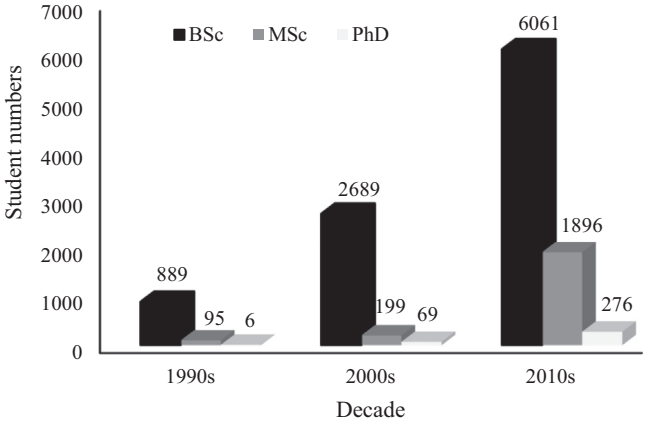

Fig. 5. Soil science student numbers at Bachelor of Science (BSc), Master of Science (MSc) and Philosophiae Doctor (PhD) degrees during different decades.

2006 to 2010, the academic staff in soil science departments of universities has increased about 26% (i.e., from 135 to 170) (Balali et al., 2018). At present time, Iranian Universities have 179 soil science faculty members (Fig. 6). Unfortunately, development of universities did not result in expanding job opportunities and the quality also fell. Baveye et al. (2006) noted that number students at Canadian universities fell by 40% between 1992 and 2004. Hartemink et al. (2008) investigated trends in student numbers in universities of USA, Europe and Australia. Results showed that soil science student numbers considerably decreased at North America and Netherlands but at Sydney University an increase was observed. Hartemink et al. (2014) explained that the numbers of soil science students are on the increase although it varies in different parts of the world.

3.3. Important issues discussed in ISSCs

The number of papers for various sub-disciplines of soil science (i.e., fertility and plant nutrition, biology, genesis and classification, chemistry, physics, conservation and erosion) during 25 years are shown in Fig. 7. The results indicated that the number of papers presented on soil fertility and the plant nutrition sub-discipline has increased more rapidly than others. The tendency of Iranian soil scientists to this discipline probably related to its direct link with the food security and agricultural production. The population of Iran has increased from 58 million in 1992 to 82 million in 2017, which requires a large volume of agricultural production. Baren et al. (2000) also explained that among the papers presented over the 16 international soil science congresses, soil fertility and the plant nutrition and soil technology sub-disciplines have the highest number.

During the thirteen ISSCs, environmental stresses (e.g., salinity and drought), fertilizer recommendation, application of organic fertilizers and interaction between elements received considerable attention in soil fertility and plant nutrition sub-discipline. Most of the soil chemistry studies focused on the micro-macro elements and contaminated soils. The soil contamination studies covered different heavy metals and their sources. The soil contamination by cadmium (Cd), lead (Pb) and nickel (Ni) were explained in the studies conducted during the previous 25 years over the thirteen ISSCs (Tofighi and Salmaci, 1998; Varasteh Khanlari, 2005; Marjovvi and Solhi, 2007). Also, studies showed that the main sources of metal contamination were (i) fertilizers, pesticides and herbicides (Charkhabi, 1998; Afros, 2005), (ii) industrial sewage (Agharazi and Pormatin, 1996; Rahmani, 1998; Bahmanyar, 2005), (iii) urban sewage (Erfahanmensh et al., 1996; Hosseinpour et al., 2005; Gholami et al., 2015), and (iv) mining (Nowroozi Goldeer et al., 2015; Chavoshi et al., 2015).

Many soil studies were undertaken to investigate the biofertilizer and bioavailability of elements in the soil biology sub-discipline. Water movement in soil and irrigation system studies have remained important issues to the present day into the soil physics sub-discipline. Many studies were undertaken to investigate hydraulic conductivity (Parsi Nejad, 1998; Doaei et al., 2005; Ghanbarian and Liaghat, 2007; Emadi and Naderi, 2015) and soil- moisture characteristic curves (Saadat et al., 1996; Rezaee and Neyshabouri, 1998; Ghanbarian et al., 2007; Ataei et al., 2015). Also, from 1992 into the early part of the 21st century the irrigation types, irrigation efficiency and irrigation water quality were the most important issues in the irrigation system studies.

Studies about the soil erosion, sediment and mechanism continued from 1992 into 2017. Many of these studies focused on the modeling of erosion and related mechanism. The results showed that the Revised Universal Soil Loss Equation (RUSLE) became one of the most widely used soil erosion models in Iran. In soil genesis and classification subdiscipline, the most important issues investigated were soil genesis and classification, soil survey using traditional and digital approaches, mineralogy, land suitability evaluation, land use change, soil micromorphology and application of new technologies such as remote sensing (RS) and geographic information system (GIS).

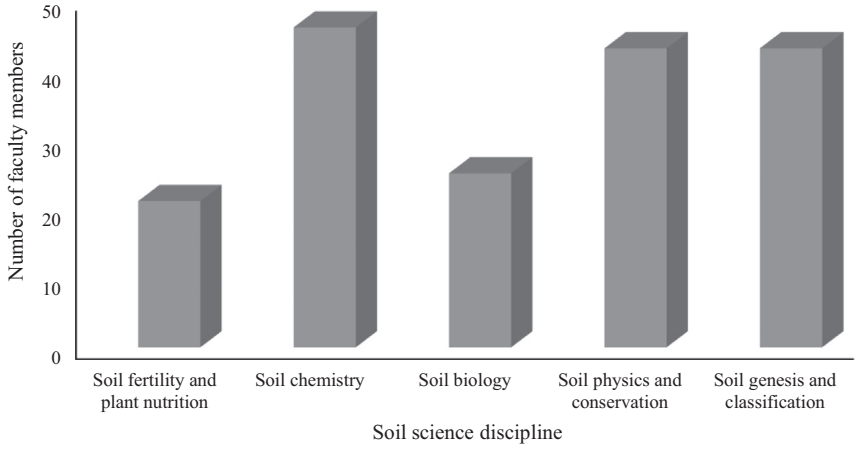

Fig. 6. Number of soil science faculty members at different disciplines in Iranian Universities.

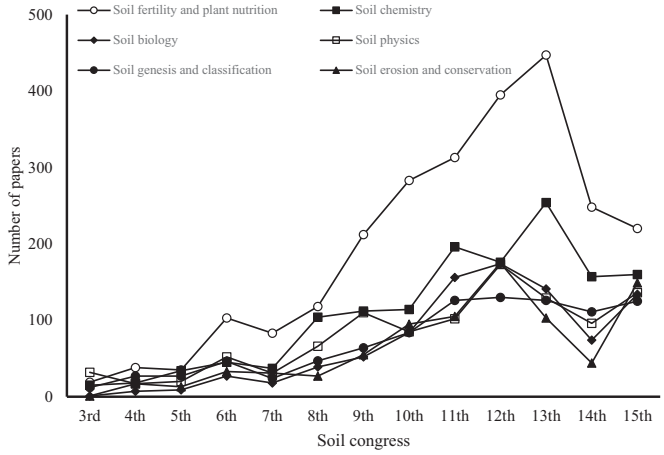

Fig. 7. Number of papers for each sub-discipline in Iranian soil congress over time from 1992 to 2017.

3.4. Trends in Iranian soil research

Fig. 8 illustrates the trends in subjects reported in different soil sub-disciplines between 1992 and 2017 in ISSCs. Fig. 8A shows that soil genesis and classification studies comprised a large part of reported work from 1992 through today. Hartemink et al. (2001) noted that one third of published papers in Geoderma from 1971 to 2001 fall into soil genesis and classification studies. In the 1940s and 1950s soil scientists in the USA began to expand the use of soil knowledge beyond agriculture and into disciplines such as land use planning, geomorphology, and the role of soil in human health (Brevik et al., 2016). Also, application of new technology in this sub-discipline has received considerable attention from mid 2000s to the early 2010s. Brevik et al. (2016) explained that with improving proximal and RS technologies, the number of possibilities for assessing the relationship between soil and more readily measurable covariates was increased in the USA.

Soil physics studies have been dominated by research into water movement in soil and irrigation type from the 1992s to 2010s. From the late 2000s to the early 2010s, application of new technologies in the soil physics discipline has quintupled (Fig. 8B). Research into biochar became common in Iran and has received considerable attention from the early 2010s through today (Fig. 8C). The first use of the term "biochar" was in 1998 at the 215th American Chemical Society National Meeting (ACSNM) to describe a solid product generated from waste biomass by gasification (Bapat and Manahan, 1998). After that, from 2006, publications using the term biochar have risen exponentially (Zheng et al., 2016). As shown in Fig. 8C, using the new technologies in soil fertility and the plant nutrition discipline has sextupled from 2007 to 2013, followed a decline in 2015. Brevik et al. (2016) explained that advances in technology led to many improvements from the 2000s in USA.

Fig. 8D shows that studies about soil and water contamination comprised a large part of reported work from 1992 through today. Studies about the macro and micro elements, saline and alkaline soils have a same trend from 1992 to the early parts of the 21st century (Fig. 8D). The application of soil knowledge to environmental problems such as contamination and water quality was probably the fastest growing non-agricultural area of soil science in the late 20th century (Brevik and Hartemink, 2010).

Soil conservation and erosion studies have been dominated by research into soil conservation and management resources (Fig. 8E) from the late 19th century to the early parts of the 21st century (1992–2017). Brevik et al. (2016) declared that studies into soil erosion and its connection with water issues in USA continued from the 1980s. In spite of the challenges of aerosols in Iran, this aspect has received relatively little attention in soil research (Fig. 8E).

3.5. Achievements of Soil Science Society of Iran

Publication of a biannual Soil Bulletin by SSSI in 1994 was a right step toward disseminating research outputs (Balali et al., 2018). Since 1998 (i.e., 6th ISSC), following the members of SSSI and the collaboration of the Soil and Water Research Institute, the Journal of Soil Research has been released. After that, the 11th ISSC was held at Gorgan University of Agricultural Sciences and Natural Resources, a contract has been concluded between the SSSI and this university to publish the scientific research journal entitled "Soil Management and Sustainable Production". In 2013, "Soil Biology" journal was added to the magazines of SSSI. The imminent publication of a scientific journal in English and a scientific-research journal of the Persian language has also been on the agenda of the forum. These journals supported by SSSI to increase our scientific knowledge at the national or regional scale.

In Iran, there are several and serious threats to soil such as the landfill of waste (industrial, urban and household) in the soil, soil degradation, desertification, extensive use of fertilizers and pesticides and soil smuggling to the Persian Gulf countries. Unfortunately, there was no legislation and/or regulations for soil protection and soil pollution prevention in Iran. From the 13th ISSC, the SSSI as the highest scientific reference in this area tried to adopt a comprehensive soil legislation and strategies for sustainable soil management. This issue was followed up seriously at the next congresses (i.e., 14th and 15th). Fortunately, with the follow up by SSSI the soil protection bill was approved and is awaiting public debate in the Islamic Consultative Assembly for becoming a law. Iranian soil scientists hope that this bill will become law

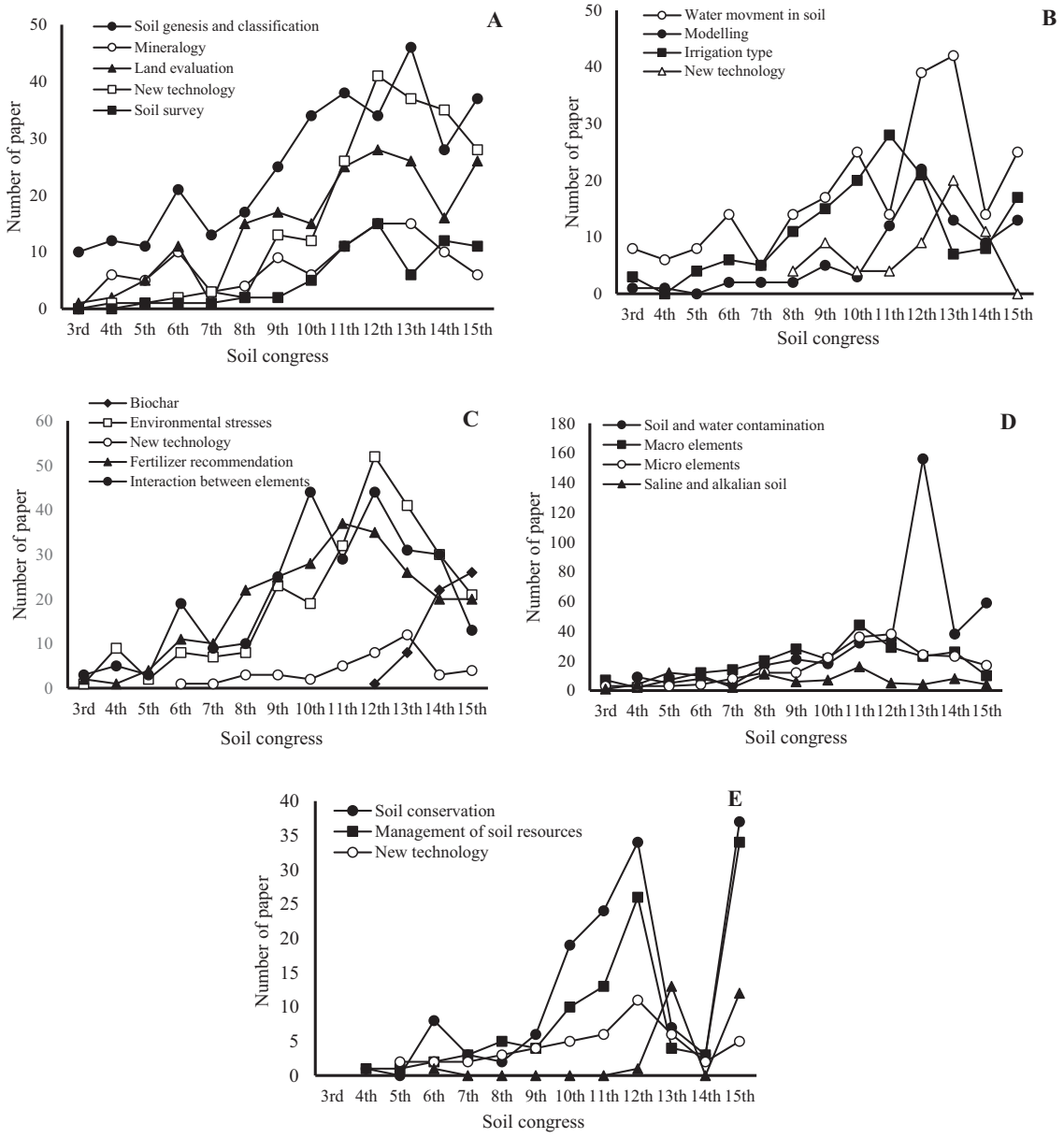

Fig. 8. Trends in subjects reported in different soil sub-discipline between 1992 and 2017. Soil genesis and classification (A), soil physics (B), soil fertility and plant nutrition (C), soil chemistry (D) and soil erosion and conservation (E).

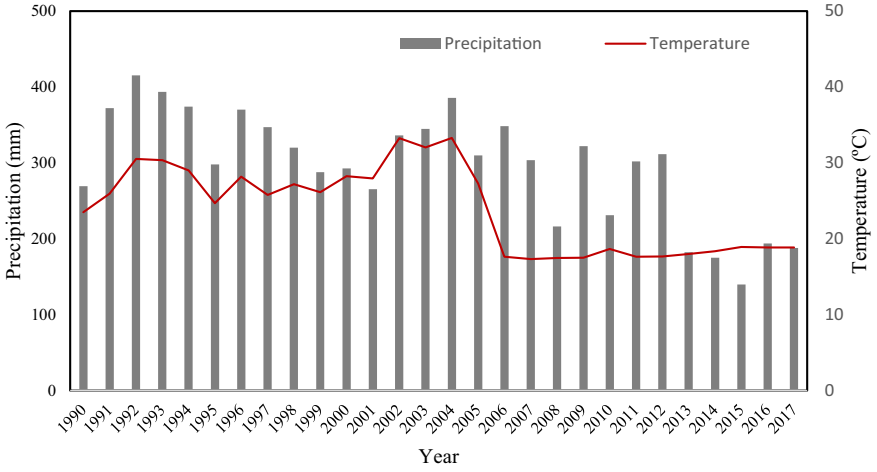

Fig. 9. Mean of precipitation and air temperature of Iran over time from 1992 to 2017.

in near future. The Soil Protection law is an effective step to deal with soil degradation and its smuggling.

Moreover, as previous mentioned there is no symmetrical distribution of soil studies in the whole country (Fig. 3). Access to studies that have been carried out in the country so far is essential for soil science community. In early part of 21st century, with collaboration between Soil and Water Research Institute (SWRI) and SSSI the book entitled "the Soils of Iran" (Roozitalab et al., 2018) that compiling all relevant soil research conducted over the last 50 years written by distinguished Iranian soil experts. This book provides comprehensive information on the management approaches needed for sustainable soil utilization and conservation under such conditions and the attendant challenges. In this book, major challenges facing the soil resources of the country are defined and recommendations are made to face the future challenges.

3.6. Challenges for Iranian soil research

According to data from Iran meteorological organization (IMO) and national oceanic and atmospheric administration (NOAA), Iran received only 188 mm rainfall in 2017. The mean precipitation across Iran dramatically decreased (55%) over time from 1992 to 2017 and is 39.5% lower than 5 years ago (Fig. 9). Water shortage is crisis in Iran and all attentions is paid to the water resources and the correct use of them. Although a climate change has occurred in recent years in Iran but the interactions between climate change and soils has not received considerable attention. Unfortunately, it seems that the future challenge in Iran is soil crisis. The climate change affects the soil health and raises concerns about soil security. It is expected that these issues will have a special place among Iranian soil scientists in future. Future research should consider that soil and water that are interconnected and without considering the soil we cannot eliminate the water crisis. Therefore, it is necessary to focus on a multi-disciplinary approach toward environmental challenges.

3.7. Future of soil science in Iran

Unfortunately, based on the results of questionnaire it can be said that Iranian soil scientists have serious concerns and some pessimism about the future of the soil science in Iran. Almost, all Iranian soil scientists believe that soil science has reached a dead end in terms of its applicability. To get out of this situation, modeling from the successful countries in this field seems necessary. At universities across the USA, Australia and Canada most of the soil science departments have been combined with other departments to create hybrid departments such as "Crop and Soil Sciences", "Earth and Soil Sciences", "Environmental Sciences", "Natural Sciences", "Geography, Environment and Soil Sciences", "Soil, Water, and Environmental Sciences", and "Renewable Resources". Brevik et al. (2016) declared that soil science had to evolve as a profession so that the soil scientists of today are not exactly the same as the soil scientists of a few decades ago. Field et al. (2011) noted that the context of the soil education must be broad because soil science has a broad holistic role and has to be involved with scientists from other disciplines. Brevik et al. (2014) explained that only few "Soil Science" departments left in USA in the last years. Therefore, Iranian soil scientists should have cross-disciplinary perspectives to address the challenges of the soil science.

The future of soil science will depend on what soil scientists will do for its progress and how to integrate soil science with other disciplines such as environmental and natural sciences? Moreover, addressing the future of soil science requires understanding current challenges about soil. On the other hand, it is not possible to talk about the future of soil science without acceptance the important role of soil (necessary element for ecosystem), soil scientists and soil professional by society. As a result, Iranian soil scientist must have a multi- disciplinary view and soil science should contribute to major global issues like sustainable food production and climate change.

4. Conclusion

From the late 2000s, the Iranian Soil Science Congress theme was adapted to harmonize with many of problems such as food and water security, ecosystem sustainability and climate change. Fortunately, based on the papers published in ISSC we can explain sometimes the Iranian soil science studies were consistent with studies conducted by international soil scientists. Isfahan Province has the highest contribution in papers compilation during different decades. The number of papers presented in the soil fertility and plant nutrition sub-discipline has increased more rapidly than others. In 2010s the number of soil science students and the members of SSSI have a considerable increase. There are several pessimism and concerns on the future of soil science in Iran. Iranian soil scientists should have cross-disciplinary perspectives to address the challenges such as soil security, food security, climate change and environmental protection. We hope that the soil bill will become law in near future to end concerns of Iranian soil community about the optimal utilization of soil resources and its smuggling. Furthermore, the perception of soil science as a profession and development of employment opportunities for soil science graduates are a prerequisite to develop and improve Iranian soil science community.

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